



# EXPLANATION OF NULL RESULTS OF MICHELSON AND MORLEY EXPERIMENT BY CLASSICAL MECHANICS PART II

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## ABSTRACT

Interferometry is the branch of optics in which experiments are conducted on wave nature of light. The light waves are superimposed to generate interference fringes and measurements are made. In these experiments where diffraction and interference are observed, the wavefront of light plays a very important role. While interpreting the results of these experiments the role of wavefront is completely ignored resulting into wrong predictions. In such an experiment conducted by Michelson and Morley to measure the velocity of earth in space the role of wavefront was ignored. It has been established by the results of Fizeau experiment and other similar experiments that speed of light is constant and it is not effected by the motion of source of light and motion of medium in which it propagates. Which later on become the second postulate of special theory of relativity. In the present article null results of Michelson and Morley experiment is discussed in a very different way keeping in view constancy of speed of light, wavefront of light and Huygen's principle according to classical mechanics

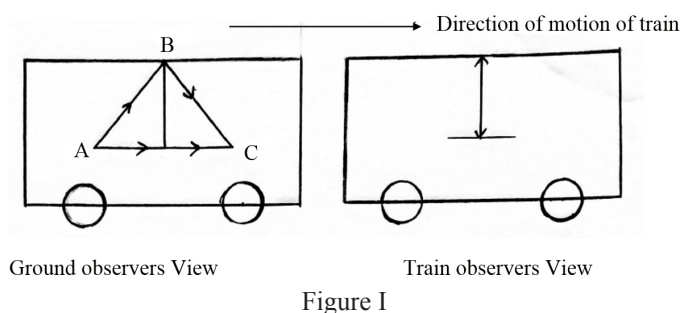
**KEYWORDS:** Interference, Light, Interferometer, Reflection

## INTRODUCTION

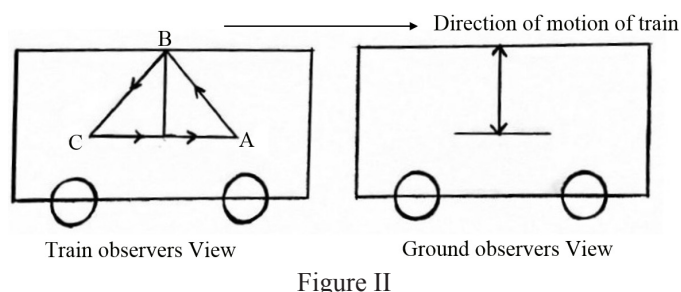
Michelson and Morley designed an Interferometer called Michelson's interferometer to measure the velocity of light in aether (space) and conducted the experiment in the year 1887. The ray of light is splitted in to two rays by a semi-silvered glass plate and one ray is sent in a direction parallel to the direction of motion of earth and the other ray is sent in perpendicular direction, both the rays are reunited after reflection from plane mirrors situated at equal distance from the glass plate and the rays interfere with each other resulting into interference pattern..The time travelled by the two rays is calculated. Thereafter the interferometer is rotated at  $90^\circ$  angle so that the pathways of two rays are inter changed and changes in the interference fringes are observed. No expected fringe shift was observed which could not be explained by classical mechanics. The present analysis of null results of Michelson and Morley experiment by classical mechanics reveals new facts not noticed earlier.

## Experiment

Before proceeding further let us discuss simple experiment and observations of different observers.. A train is moving at high speed on the track and an observer sitting in the train throws a ball towards the roof of the train and observes the movement of ball in train's frame of reference. He observes that ball has gone up in straight line and struck at the roof and has come down straight forward, but an observer standing on the ground observes that ball has adopted oblique path ABC as shown in Fig I



Let us repeat the same experiment when ball do not gain the velocity and direction of motion of train, the observations of the observers will be different.. In this case ball will go in straight line and return in the same straight line as per ground observer, but the observer in train will observe that ball has adopted oblique path ABC as shown in Fig II



Different observers are observing different things, but they cannot change the reality. Reality is not a relative phenomenon, it remains only one.

The above thought experiment indicates that the ball's frame of reference was always right.. Similarly light is that one ball

which is not effected by the velocity and direction of motion of earth in Michelson and Morley experiment and light does not adopt oblique path in perpendicular direction, but in all previous works oblique path has been considered while calculating the time taken by light ray in perpendicular direction which is not correct. The oblique path can only be adopted by light ray in three circumstances.

1. When the light is completely dragged along by the earth or the medium in it's direction of motion.
2. When there is diffuse reflection of light at the plane mirror when movement is in microseconds level.
3. When the spherical wavefront of light source is not perfectly converted in to plane wavefront by the convex lens at the level of microseconds movement of light, because light completes its journey in 0.1 microsecond in the arms of Michelson and Morley experiment and deviation of light from normal is approximately 40 arc seconds which changes the result as a whole..

The first possibility is ruled out by the results of various experiments such as Fizeau experiment, Hammar experiment and stellar aberration of light.. The second and third possibilities are playing their role, both of which have identical effects..

Let us discuss when light behaves according to diffuse reflection or semi-spherical nature of wavefront of light as it is not completely reduced to plane wavefront by convex lens at microsecond level events.

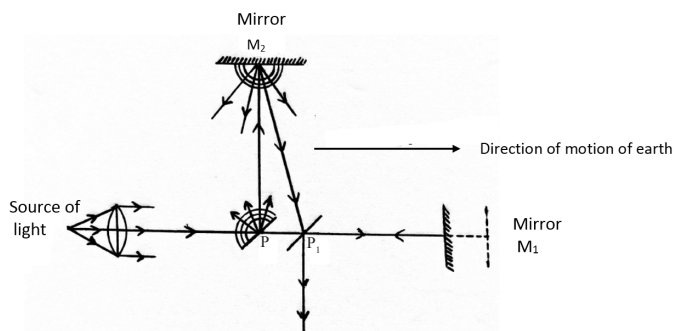


Fig III Set up of Michelson and Morley experiment

As shown in Figure III light after reflection from mirror  $M_2$  reaches at the plate at  $P_1$  by adopting the path  $PM_2P_1$  due to diffuse reflection or spherical nature wavefront. Let us calculate the time taken by the ray of light from P to  $M_2$  to  $P_1$

Let the time taken by light with velocity  $c$  to complete this path be  $t$ . The distance  $PM_2=L$ , where  $L$  is the distance of mirror  $M_1$  and  $M_2$  from plate P and distance  $PP_1 = vt$  where  $v$  is the velocity of interferometer/ earth/ As per Pythagoras

Theorem  $(M_2P_1)^2 = (PM_2)^2 + (PP_1)^2$

$$(M_2P_1)^2 = L^2 + (vt)^2$$

$$M_2P_1 = \sqrt{L^2 + v^2t^2}$$

Therefore time  $t$  taken by light from  $PM_2P_1$  will be as under

$$t = \frac{L}{c} + \frac{\sqrt{L^2 + v^2t^2}}{c}$$

$$ct - L = \sqrt{L^2 + v^2t^2}$$

$$(ct - L)^2 = L^2 + v^2t^2$$

$$c^2t^2 + L^2 - 2tLc = L^2 + v^2t^2$$

$$t^2(c^2 - v^2) = 2tLc$$

$$t = \frac{2Lc}{c^2 - v^2}$$

$$t = \frac{2L}{c} \frac{1}{1 - \frac{v^2}{c^2}} \dots\dots\dots I$$

The time taken by the ray of light going towards Mirror  $M_1$  and back in the direction of motion of earth will be as under.

For inward journey time  $t_1 = \frac{L}{c-v}$

and for outward journey time  $t_2 = \frac{L}{c+v}$

Total time  $t = t_1 + t_2 = \frac{L}{c-v} + \frac{L}{c+v}$

$$t = \frac{Lc + Lv + Lc - Lv}{c^2 - v^2}$$

$$t = \frac{2Lc}{c^2 - v^2}$$

$$t = \frac{2L}{c} \frac{1}{1 - \frac{v^2}{c^2}} \dots\dots\dots II$$

As per equation No I and II both the rays of light are taking equal time and similar will be the position on the rotation of interferometer at the angle of  $90^\circ$ . No path difference is involved due to motion of earth hence null results are in consistent with classical mechanics.

## CONCLUSION

Light itself is a universal frame of reference, it is not effected by the motion of source of light or motion of apparatus or motion of medium, it travels independently with constant speed after emission from the source. The equipments are not relative observer, equipments record events in real sense. Analysis of null results of Michelson and Morley experiment is to be made keeping in view lights frame of reference. No length contraction like phenomenon exist. Results of Raleigh and Brace experiment also confirms that there is no length contraction in the direction of motion of earth. Sagnac experiment has also proved that movements of objects before reaching of light at a point are completely effective.. In the case of light relative velocities are measurable in two ways, real addition of velocities and virtual addition of velocities.. No real addition or subtraction

of velocities is possible in the velocity of light, virtual addition and subtraction of velocities are accountable in the case of light also according to classical mechanics.

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